甘蔗葉燒病

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一　導言

一九四九年六月虎尾甘蔗改良場試驗區之 Co. 290 首先發現葉片枯乾病害，旋因面積甚小，不久即由該場挖毀，迨本年四、五月間，本病又重新在該場發生，且有蔓延其他品種之勢，繼又在曾文甘蔗改良場，臺南糖業試驗所，橋子頭品種試驗區等地之 Co. 290, 均發生同樣病害，十一月六日作者等又發現屏東本所之交配親本品種區中一小區之 Co. 290 亦患同病，因深恐本病傳播蔓延，作者等遂加緊研究，俾能探明病原及早防除。

二　病徵

本病發生於稍部已展開第二三葉葉以下之葉片部份，初期於表皮上呈紅褐色小點，周圍黃色，作紡錘狀，大約0.5—3.0×0.3—1.0公厘，次沿維管束延長擴大，各點連接，周圍之組織逐漸變成淡黃色，繼而赤色，更沿此變色部枯乾；枯乾之部份呈褐色，邊緣褐色，形成一長紡錘狀枯條斑，兩端帶少許黃褐色延長；全斑條之短長不一，由5×0.3至17×1.0公分以上，位置不定，或在葉片之中央，或在邊緣，惟後期皆沿葉尖方向延長擴大，互相

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* 本文蒙路所長君讀校閱謹誌謝忱。

併合而成一片枯葉，中脉則未見被害；已枯乾部份之上面或下面，有時上下兩面，其組織內埋藏無數黑色小點，此爲病原菌之胞子體(參閱版圖1)；葉肉及葉鞘均正常，未見有何病徵。

本病之後期，使葉片完全枯乾，病徵異常注目，故定名爲"甘蔗葉燒病"(Leaf scorch of sugarcane)。

本病形成斑條時期，肉眼視之頗似枯條病[7]，但本病之斑條較短，且其枯乾部份並非沿淡黃色之長斑條緩緩進行，後期復擴大使全葉枯死，皆其相異之處。

三　品種間之感染程度

本病對甘蔗品種間之感染程度，顯有不同差異，茲就虎尾甘蔗改良場及屏東本所於Co. 290惠株周圍之品種，對其感染程度之調查結果，列如表一。

表 1　甘蔗品種對葉燒病之感染程度調查表

Table 1.　Susceptibility of sugarcane varieties to leaf scorch disease

品種 Varieties	虎尾 Huwei	屏東 Pingtung	品種 Varieties	虎尾 Huwei	屏東 Pingtung
Bamboo cane		−	F. 132	++	
Chunnee		++	F. 134	++	
Co. 290	+++++	+++++	H. 28−5118		+
Co. 281		+	Kasseor		+
Co. 285		+++++	NCo. 310	+	
Co. 331		*	P.O.J. 2883	++	
Co. 351		+++	P.T. 28−71		+
Co. 353		++	P.T. 28−72		+
Co. 421		*	P.T. 31−100		++
Co. x	++++		P.T. 31−103		+++
C.P. 33−310		+++	P.T. 33−84		++
Ek 28		+	P.T. 43−52	+	
F. 108	+	+	P.T. 43−695	++++	
F. 110	++++		P.T. 46−144	+	
			P.T. 46−190		+++
			Robustum		+
			Uba		−

備註 Remarks：

"−" 無病徵 (No symptom of leaf scorch disease)

"+" 數目之多少示其感染之重或輕 (Comparative amount of susceptibility)

"*" 示能感染，但非在病區，故不能比較其程度 (Susceptible, not in the diseased plots so the comparative amount is not given)

四 病株之損失

屏東本所之 Co. 290 染病區（本所試驗地編號第二十六區）適另有健株二小區，曾於十一月七日測定糖度一次，平均健株爲 17.88±1.3 度，病株爲 15.91±0.3 度，相較病株減少 1.91度，差異顯著；十一月廿九、三十兩日分別隨機取樣，病健株各二十莖，計算有葉數，莖量及蔗汁分析，結果如表二。

有葉數之計算標準如下：

健全葉＝1

1—2病斑者＝¾

病斑枯乾部份佔全葉½者＝⅜

病斑枯乾部份佔全葉⅓者＝⅖

病斑枯乾部份佔全葉¼者＝⅛

然後將總數平均而得。

莖長一律採自最接近地面部份至張開葉下第六節爲止。

表 2 Co. 290 葉燒病病株與健株有葉莖量及蔗汁分析比較表

Table 2. Comparative data of healthy and leaf scorch diseased Co. 290

項目 Items		健株 Healthy	病株 Diseased	健一病 Healthy vs diseased	病莖損失% Loss %
有葉數 No. of green leaves		11.10	4.33	6.77	61.0
莖量 Stem	莖重 weight kg.	1.99±0.82	1.65±0.96	0.34公斤*	17.1
	莖長 length. m.	2.98±0.20	2.84±0.26	0.14公尺*	4.7
	莖徑 diam. cm.	2.89±0.21	2.70±0.19	0.19公分*	
蔗汁分析 Analysis of cane juice	糖度 Brix	19.27±1.54	17.42±0.99	1.85*	
	含糖率 Polarization	16.84±0.29	14.75±1.09	2.09*	
	純度 Purity	87.19±0.38	84.53±6.31	2.66*	
	還元糖 Reducing sugar	0.77±0.37	0.71±0.18	0.06*	
纖維 Fiber		11.78±0.85	11.28±0.85	0.50*	
蔗分 Sucrose		13.36±0.67	11.77±0.59	1.57*	
標準產糖率 Standard Sugar yield		11.90±0.67	10.32±0.87	1.58*	13.2

* 差異極顯著 ($P < 0.01$)

由表二觀之，病株之產量減低達17.1%，標準產糖率降低13.2%，其損失之大至堪重視。

五 病原菌

菌絲無色，有隔膜，多侵入於患部維管束之木質部中（版圖4），分生胞子果(pycnidia)散生，球形或扁球形，直徑150—228μ，深褐色，膜質，周圍菌絲不發達，厚13.7—17.1μ，中央具一圓形開孔，直徑17.1—27.4μ，多數爲17.1μ，作乳頭狀突起（版圖2），分生胞子無色，大小爲24—58.3×8.5—13.8μ，多數爲44.6—51.5×10.3μ，橢圓紡錘狀，基端圓形或稍切形，末端尖形；通常均三個隔膜，惟亦有極少數爲一個或四個隔膜者，每隔膜處均明顯凹陷；成熟胞子每胞中均有1—2個大型油點（版圖3），萌發管圓柱形，無色，多由每胞側生；分生胞子柄(conidiophore)無色，短小，2.1—3.4×3.4μ。（本菌爲一新種，其拉丁文描寫見英文篇中）

六 病原菌鑑定

本菌屬不完全菌類 (Fungi Imperfecti)，擬球果菌目 (Sphaeropsidales)，擬球果菌科 (Sphaeioidaceae), Stagonospora 屬。此屬眞菌在臺灣已有報告者僅二種[8, 9]，名爲 *Stagonospora machili* 與 *S. erythrinae*，然此兩種分生胞子之形態及大小等均與本菌不同。

此屬之眞菌在 Saccardo's Sylloge Fungorum, Review of Applied Mycology, Annales Mycologici, Mycologia 等報告中共有兩百餘種，以寄生於 *Andropogonis furcati* 之 *Stagonospora simplicior*[6] 與本菌較近似，其分生胞子亦無色，三個隔膜，紡錘狀，隔膜處明顯凹陷，然其大小不但與本菌不同，且其分生胞子之兩端爲圓形，而本菌者則基端爲圓形或稍切形，末端爲尖形。若着重於分生胞子之末端爲尖形，且具三個隔膜時，則 *S. Anemones*[1, 2] 具有此特徵，然該菌分生胞子之隔膜處並不凹陷，而與本菌相異，故作者等將本菌定名爲：

Stagonospora sacchari

茲將本菌與相近者之區別檢索如下：

分生胞子無色，三個隔膜，隔膜處明顯凹陷

A. 分生胞子紡錘狀

B. 分生胞子大於20μ長，8μ寬

C. 分生胞子兩端圓形

S. simplicior

CC. 分生胞子末端尖形

S. sacchari

BB. 分生胞子小於 20μ 長，8μ 寬

S. Fragariae(3), 等等

AA. 分生胞子非紡錘狀

S. Typhoidearum(5), 等等

或

分生胞子無色，三個隔膜，末端尖形

A. 分生胞子隔膜處不凹陷

S. Anémones

AA. 分生胞子隔膜處凹陷

S. sacchari

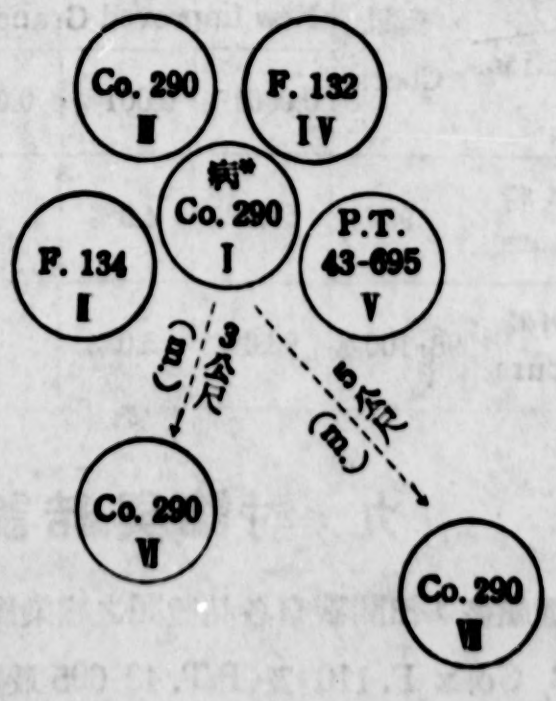
七 人工接種及傳播方法試驗

(一) 人工接種試驗：

十一月二十日用分生胞子懸液舉行人工接種試驗，計刺傷葉片上表皮，刺傷葉片下表皮，不刺傷葉片上表皮及不刺傷葉下表皮等四項接種，結果分生胞子均能侵入，藉此證明本菌胞子不必須寄主葉片有傷口時方可侵入爲害。

(二) 傳播方法試驗：

十月六日用大型栽培缸，移植 Co. 290 病株一株（病株移自橘子頭）周圍植同齡之易感染品種 Co. 290, F. 132, P.T. 43-695 及 F. 134 等健株各一，令其葉片互相接觸，另二缸各栽培 Co. 290 健株，作三公尺及五公尺之隔離，其排列如右圖：



* Disease stool

十一月廿日便發現 II, III, IV, V及VII各缸產生相同病徵，可知本病之傳播方式，至少風爲重要因子之一。

八　分生胞子萌芽試驗

十一月二十二日，將病葉上分生胞子果中之分生胞子挑出，置於玻片上，加以清水，令其萌發，室溫爲 28.5℃, 重複四次之平均數如表三，指出本菌胞子經五小時後便幾全部萌發。

表 3　清水懸液內分生胞子之萌芽率

Table 3. Percentage of germination of conidia of S. sacchari in pure water at temperature of 28.5 ℃.

培養時間 Incubation period	1小時 1 hour	2小時 2 hours	3小時 3 hours	4小時 4 hours	5小時 5 hours	6小時 6 hours
萌芽率 % % of Germination	0	6.75	14.25	28.0	85.0	97.0

十一月二十三日利用0.0001%, 0.001%, 0.01%穀樂生 (New Improved Granosan); 0.01% 及0.1% 之硫酸銅； 及2-2-50 式，4-4-50 式之波爾多液等殺菌劑行本菌分生胞子萌發試驗，結果如表四。

由表四之結果，0.01%之穀樂生，0.1%之硫酸銅，2-2-50 或4-4-50 之波爾多液均可阻止本菌胞子之萌發。

表 4　藥劑對 S. sacchari 分生胞子萌芽之影響

Table 4. The effect of fungicides on the germination of conidia of S. sacchari

藥劑 Fungicides / 濃度 Concentrations / 培養時間 Incubation period		對照 Check	穀樂生 New Improved Granosan			硫酸銅 Copper sulfate		波爾多液 Bordeaux mixture	
			0.0001%	0.001%	0.01%	0.01%	0.1%	2-2-50	4-4-50
萌芽率 Percentage of Germiration	四小時 4 hours	90%	67.5%	4.5%	0	1.0%	0	0	0
	二十小時 20 hours	98-100%	96.0%	5.0%	0	4.0%	0	0	0

九　討論與結論

本病爲害甘蔗品種頗多，田間觀察各品種間之感染程度，顯有相對性之差別，諸品種中以Co. 290, Co. 285, Co. x F. 110 及 P.T. 43-695 最爲感染，但 Co. 281 雖與被害嚴重

之 Co. 290 毗鄰而受害極微；又 Uba 間於均已被害之 Chunnee 及 Robustum 之中，竹蔗間於 Robustum 及 C.P. 33-310 之中，但皆無病徵發現。餘如 F. 108, P.T. 43-52, NCo. 310 等均較抵抗。

病原菌菌絲多在維管束內之木質部（版圖 4），故患部受其封閉水份流通，似爲釀成枯條並漸次向葉尖枯乾之後果。

本病因能隨風傳播，同一區內之易感染種，至易受害，故病株損失之比較資料，頗難獲得，屏東本所之第二十六區，適有去年秋植之 Co. 290 三小區，其中一小區被害，餘二小區則否，因此比較工作得以進行；比較結果，各項差異均極顯著，其中還元糖一項，健株較病株高，此示健株尚未臻于完全成熟，苟假以時日，健株可能繼續集積糖分，故若延至收穫期，健病之差異程度恐將較表二之結果更大。病株產糖量降低至 28.08%（莖重×標準產糖率）之多，其降低原因，對青葉數之銳減，恐爲最重要之因子。

本病發生皆先在 Co. 290 品種，然後向周圍品種傳播，茲不論病原菌是否潛伏于 Co. 290，惟其易感染至此，至少該品種在本省栽培，已具此一大缺點，故 Co. 290 明年度不宜再參加區域試驗，以免病原菌藉此播送；而本年度之被害株，宜即燒毀，藉以撲滅現有之病原菌；至於藥劑防除，本文表四僅屬初步實驗室之結果，爲避免病原菌再度爲害計，被害區可於明年三四月間，試行上述之藥劑噴霧。

十 參攷文獻 (Literature Cited)

1. Saccardo, P. A.; Sylloge Fungorum Additamenta ad Vol. I.-IV. p. 443, 1886.
2. Saccardo, P. A.; Sylloge Fungorum 10: 333, 1892.
3. Saccardo, P. A.; Sylloge Fungorum 10: 333-334, 1892.
4. Saccardo, P. A.; Sylloge Fungerum 10: 336, 1892.
5. Saccardo, P. A.; Sylloge Fungorum 14: 963, 1899.
6. Saccardo, P. A.; Sylloge Fungorum 25: 366, 1931.
7. 羅宗僖 臺灣之新蔗病—枯條病 甘蔗研究 2 (11): 1-8, 1948
8. 澤田兼吉 臺灣產菌類調查報告 9: 152, 1943
9. 澤田兼吉 臺灣產菌類調查報告 10: 56, 1944

十一 版圖說明

1. Co.290葉片上之葉燒病病徵（左：葉片上之典型長紡錘狀病斑；右：葉片上病徵之後期）

Plate 1. Symptom of leaf scorch of sugarcune on the leaves of Co. 290 (right: typical symptom of this disease showing the spindle-like streaks; left: eventual stage)

2. 葉燒病病原菌分生胞子果之剖面

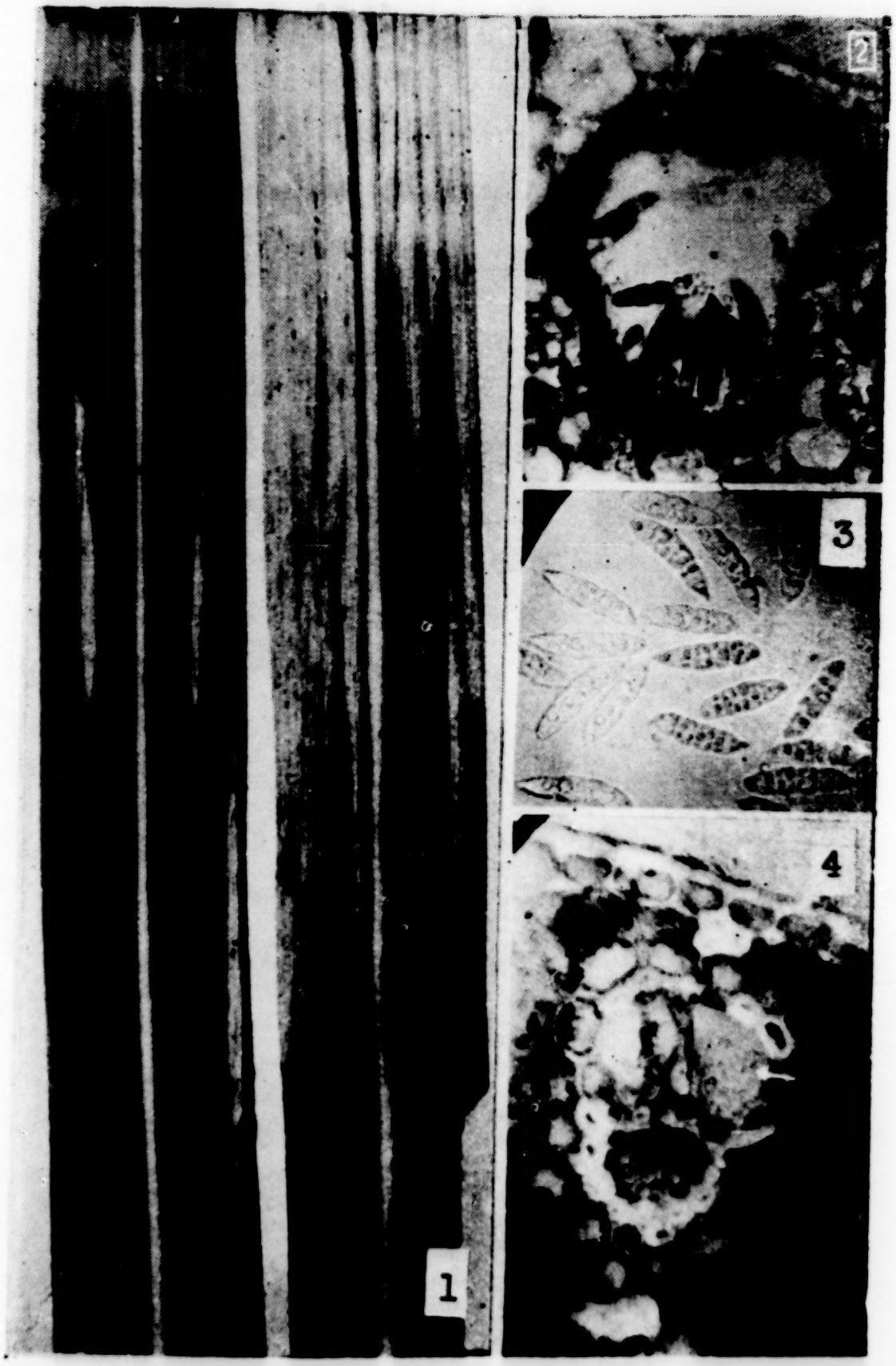
Plate 2. Section of pycnidinm of *Stagonospora sacchari* (stained with cotton blue) × 250

3. 葉燒病病原菌之分生胞子

Plate 3. Conidia of *S. sacchari* × 250

4. 病葉切面示菌絲長於木質部內

Plate 4. Section of diseased leaf showing the mycelia of *S. sacchari* in the vessel as white arrow indicated × 250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LEAF SCORCH OF SUGARCANE

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INTRODUCTION

In June of 1949, a small area of Co. 290 in Huwei Sugarcane Improved Station was caused by a disease which was recognized by the symptom of badly dry leaves. Though these diseased canes were eradicated after appearance, yet it was reoccurred in the early summer of present year. It occurred not only in the field of Huwei but also in Tseng-wen Sugarcane Improved Station, Chiao-tzi-tow, and Taiwan Sugar Experiment Station (both Tainan and Pingtung Stations). It has shown that this disease is going to spread into several regions in which it was not known before, and its menace is apparently. Since this disease is new in this island and there is no previous record can be referred. The present study was the first report made by these writers recently.

SYMPTOMATOLOGYV

The symptom of this disease is shown only on the leaf blades below the second or third unrolled leaves from spindle. The initial symptom of this disease is recognized by the presence of many minute spots on the leaf blades. These spots are spindle shape, red to dark brown color with a definite yellowish halo, 0.5-3.0 × 0.3-1.0 mm. in size. These spots elongate along the vascular bundles showing red color streak and coalesce one another. Then, the lesions form spindle-like streak, usually 5 × 0.3 to 17 × 1.0 cm. or more,

straw color with red dark brown edges, the surrounding tissues become yellowish discoloration. There are many minute black dots scattered and immersed in the dead tissue of lesions, these black dots are the fruiting bodies of pathogen. In later, these lesions may extend toward the tip of leaf and eventually cause the death of leaves except the midrib remains its intact green color (Plate 1). No abnormal characteristics have been found in leaf sheath and stem of the diseased cane. This disease has been made very serious, dry or scorching on the diseased leaves of sugarcane in all localities, This disease has been given the name "LEAF SCORCH OF SUGARCANE" tentatively by these authors.

VARIETAL SUSCEPTIBILITY

Varietal susceptibility is apparently different. Survey of the disease has been made around diseased plots in Huwei and Pingtung. The most susceptible variety is Co. 290, and those such as Co. 285, Co. x, F. 110, and P.T. 43-695 are also very susceptible, Co. 281, F. 108, P.T. 43-52 and NCo. 310 are less susceptible, while Uba and bamboo cane are comparatively resistant (Table 1).

COMPARISON OF HEALTHY AND DISEASED CANES

In Pingtung, there are three replications of Co. 290 being planted in the same block, one of it was caused by this disease. In Nov. 29 and 30 1950, the comparison of tonnage and sugar yield between healthy and diseased canes has been made. The results are shown in Table 2. It indicates very significantly difference both in tonnage and sugar yield. However, the diseased stools decreased tonnage as high as 17.1%, and the standard sugar yield decreased 13.2%; inverse sugar in healthy stools is higher than the diseased ones, that means that the growth of the former is still going on, while the latter has delayed or even stopped growth since the disease has attacked severe on the leaves of them.

CAUSAL ORGANISM

Stagonospora sacchari sp. nov.

Pycnidia immersed in the tissue of leaves, scattered, ephiphyllous, hypophyllous or amphigenous, subspherical to spherical, dark brown in color, 150-228μ in diameter; pycnidial wall membranaceous, 13.7-17.1μ in thickness; ostiole slightly raised and protruding, 17.1-27.4μ in diameter (Plate 2); conidia hyaline, elliptical-fusiform, apex tapering, basal end rounded or somewhat truncates straight or slightly curved, 24-58.3 $\times$ 8.5-13.8μ (usually 44.6-51.5 $\times$ 10.3μ), triseptate, rarely 1- or 4-septate, constricted at septa, mature conidia containing 1-2 granules in each cell (Plate 3); conidiophores hyaline, short, 2.1-3.4 $\times$ 3.4μ.

Pycnidiis in laminis foliroum immersis, sparsis, ephiphyllis, hypophyllis vel amphigenis, subsphericis aut sphericis, atratis brunneis, membranaceis, 150-228μ diametris, ostiolis leniter elevatis pertundentribus, 17.1-27.4μ diametris; conidiis hyalinis, elliptiaceo-fusiformibus, apice attenuatis, basique apiculo rotundatis vel nonnihil truncatis, rectis vel leniter curvulis, 24-58.3 $\times$ 8.5-13.8μ (plerumque 44.6-51.5 $\times$ 10.3μ), triseptatis, raro 1- vel 4-septatis, quandoque at septa constrictis, 1-2 guttulatis in quisque maturis partito; sporophoris hyalinis, brevis, 2.1-3.4$\times$3.4μ.

Hab. in foliis *Saccharum officinarum* L., in Taiwan, China.

TAXONOMY

In Taiwan, there are only two species of *Stagonospora* reported by Sawada [8, 9] viz. *S. Machili*, and *S. Erythrinae* which caused the diseases of *Machilus Makinoi* Hay and *M. Thumbergii* S. et Z. and *Erythrina variegata* L. var. *orientalis* Merr. In these two species, both shape and size of conidia are different from present species.

In the genus *Stagonospora*, there are more than two hundred species in Saccardo's Sylloge Fungorum, Review of Applied Mycology, Annales Mycologici, and Mycologia, etc. Among them there is only one species with somewhat similarity to present one on the condition that the characteristics of conidia are hyaline, chiefly 3-septate, constricted at septa, fusiform, and over 20 $\times$ 8μ in size. It named S. simplicior [6] which was described on *Andropogonis furcati* as conidia oblong-fusoid, straight, both ends rounded,

33-40 × 9-9.5μ, 3-septate, constricted, hyaline; the conidia of the same species which appeared on *Phragmitis commuis*(4) was described as oblong, obtuse, hyaline, 3-septate, at septa irregularly constricted, 32-38 × 8-9μ in size. It is clearly to know that this species is apparently different from present species on the conidia of both ends rounded. In the point of conidia hyaline, 3-septate, one apex tapering, S. Anemones(1, 2) seems closely related to present species, it was described as conidia cylindrical, one apex slightly attenuated, hyaline, straight or slightly cruved, 3-septate, 26-30 × 3-4μ. In the comparative study, this species is not constricted at septa and smaller width of conidia, therefore it is apparently different from present species.

The present species of *Stagonospora* on *Saccharum officinarum* appears capable of being distinguished on the following basis:

Conidia hyaline, chiefly 3-septate, constricted at septa.

A. Conidia fusiform.

B. Conidia over 20μ long, 8μ width.

C. Conidia both ends rounded.

S. simplicior

CC. Conidia one apex tapering.

S. sacchari

BB. Conidia not over 20μ long, 8μ width.

S. Fragariae (3), etc.

AA. Conidia not fusiform.

S. Typhoidearum (5), etc.

or

Conidia hyaline, 3-septate, one apex tapering.

A. Conidia not constricted at septa.

S. Anemones

AA. Conidia constricted at septa.

S. sacchari

INOCULATION AND TRANSMISSION

The spore suspension was inoculated on the healthy leaves of Co. 290 canes. It proved that the conidia get infection through upper or lower epidermis with or without artificial wounded.

The healthy canes were planted near the diseased one as shown in p. 327. Although the healthy Co. 290 was at a distance of five meters from diseased cane yet it still caused by the same pathogen which dismissed from diseased leaves. In this study, however, it shows that the wind is, at least, one of the spreading agent for this disease.

GERMINATION OF CONIDIA

The germination of conidia was made by hanging method on slides. Conidia of this fungus mostly germinate after incubation at 28.5 °C. for five hours in pure water (Table 3).

A preliminary study of several kinds of fungicides for spore germination was made. The results are shown in Table 4. There no spore can germinate in the media of 0.01% New Improved Granosan, 0.1% copper sulfate, 2-2-50, and 4-4-50 Bordeaux mixture.

CONCLUSION

Varietal susceptibility is apparently different to this disease. As Co. 281 which is planted closely near to the serious diseased stools of Co. 290 shows disease slightly. The Uba cane and Bamboo cane which are planted among diseased stools of Chunnee, Robustum and C. P. 33-310 show no symptom. This indicates that the Uba and bamboo canes are comparatively resistant to this leaf scorch disease.

Mycelia of *S. sacchari* infect the xylem of the host tissue as shown in Plate 4. It seems to suggest that the scorching the diseased leaves is due to the broken of water supply.

The tonnage and sugar yield are decreased in the diseased canes. The decrease of the number of green leaves seems to have noticeable relationship on such lowering in tonnage and sugar yield.

Control measures are recommended to eradicate the diseased stools immediately for the eliminating of inoculum. This is the most practicable and effective way under present conditions. For prevention of this disease, the above mentioned fungicides can be used for spraying in diseased blocks during March or April in the next year.

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